# Microgrids opportunities within Spain's Smart Grids initiatives




Santiago 2013
SYMPOSIUM ON MICROGRIDS

September
11-12


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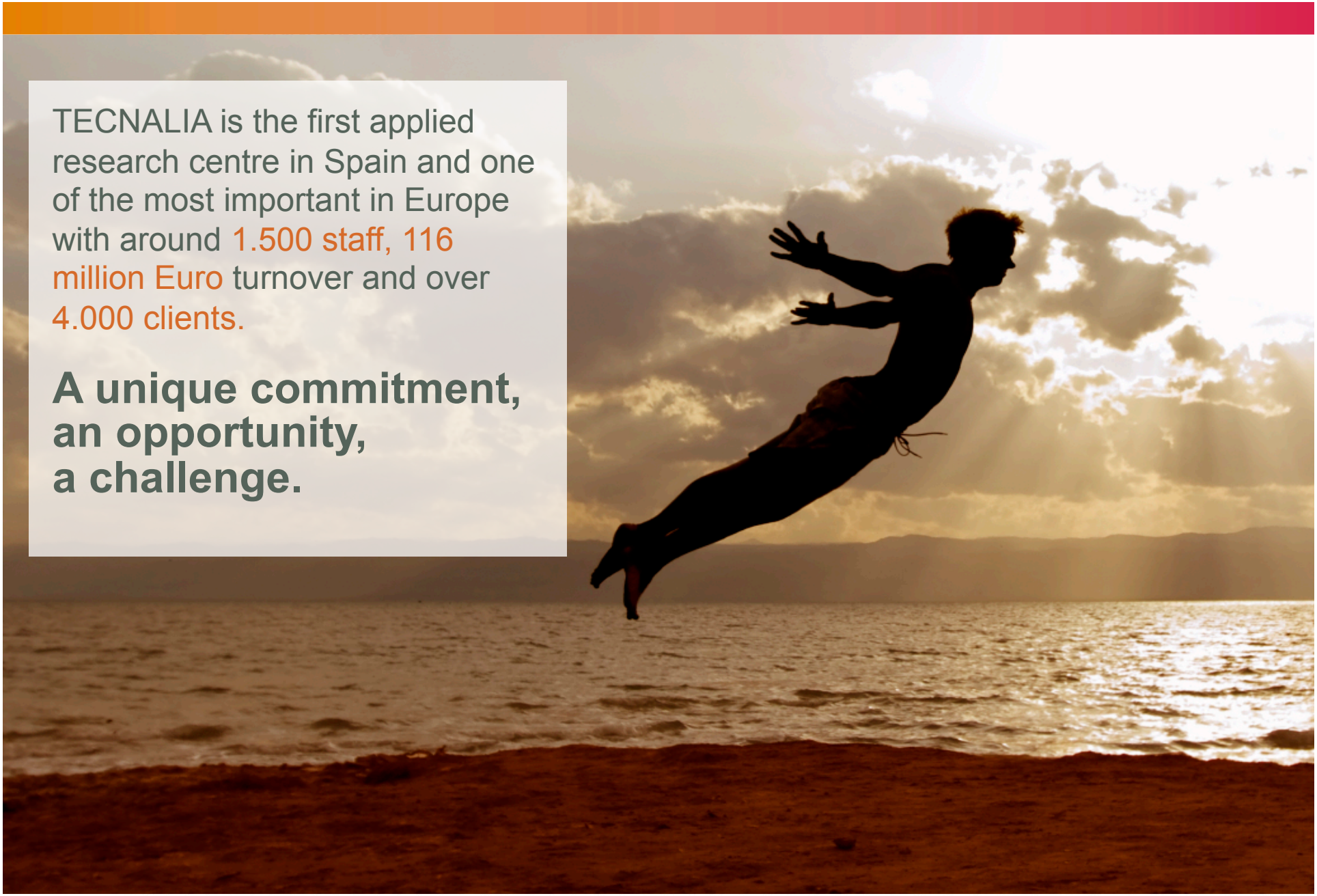

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**A unique commitment, an opportunity, a challenge.**

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ENERGY & ENVIRONMENT

INDUSTRY & TRANSPORT

ICT - European Software Institute

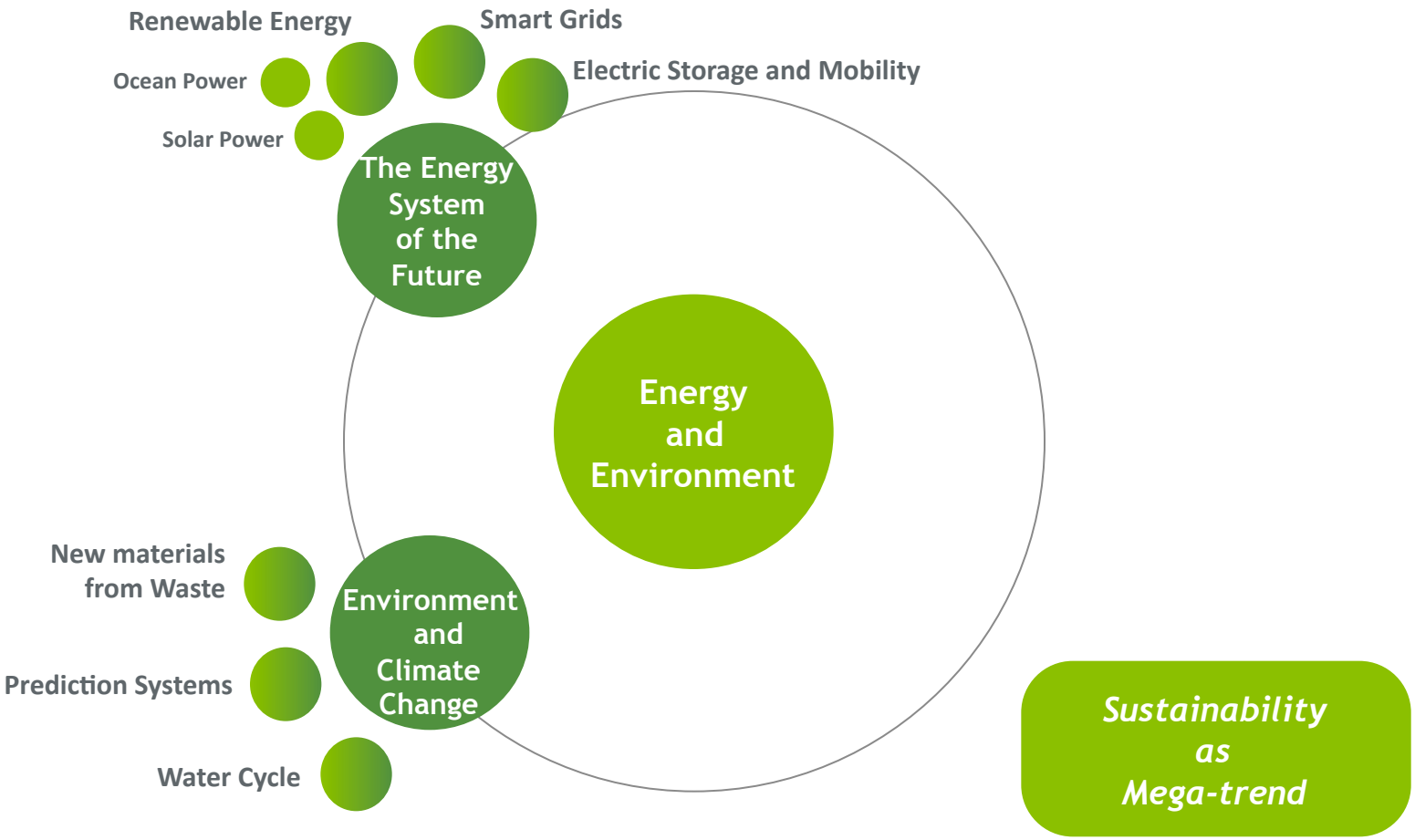
HEALTH

INNOVATION STRATEGIES

TECHNOLOGICAL SERVICES

SUSTAINABLE CONSTRUCTION

# ENERGY AND ENVIRONMENT// Challenges and Research Lines

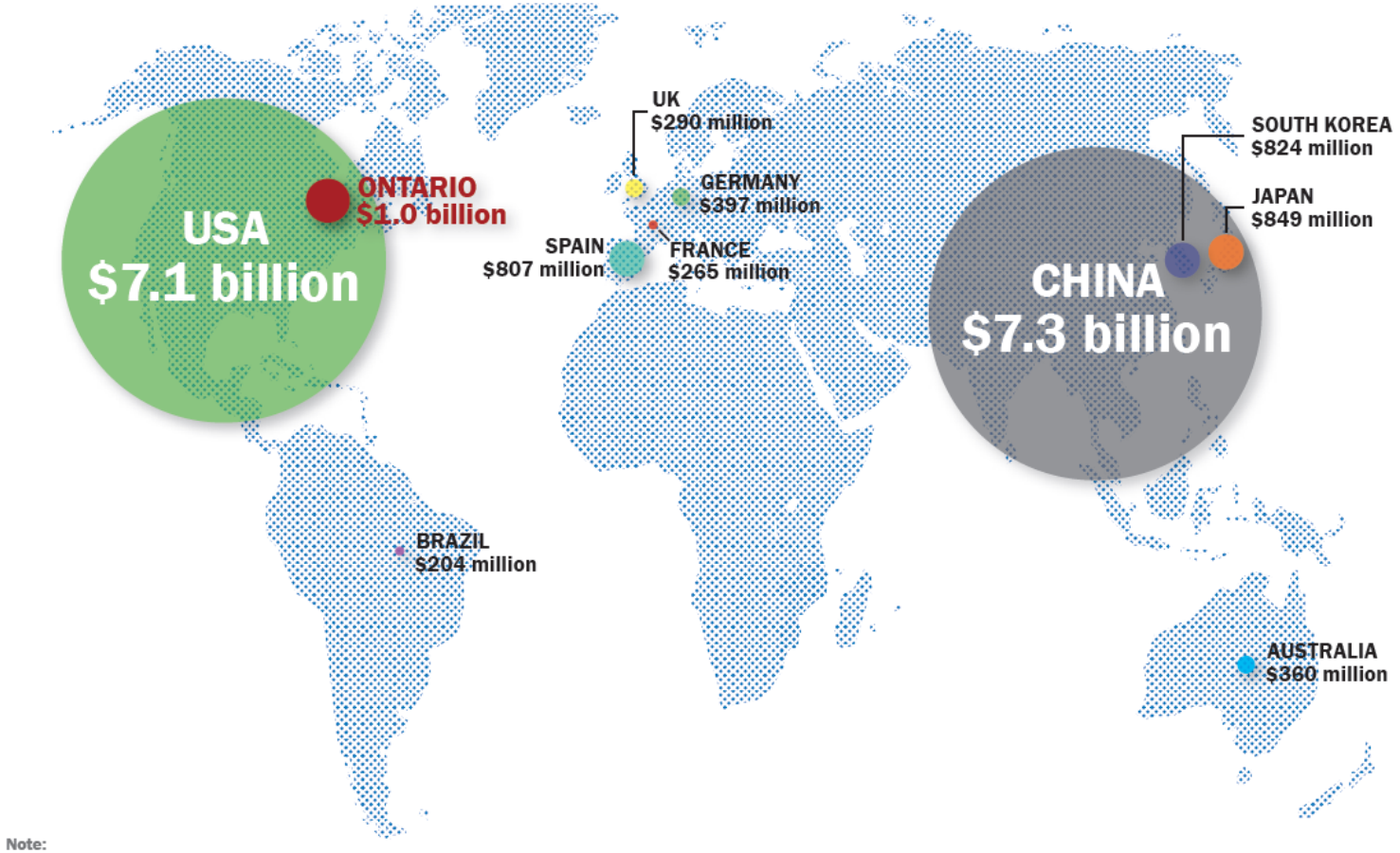


# Content

1. Smart Grids market in Spain
2. Reference of main SG initiatives
3. Opportunities for microgrids projects
4. Conclusions

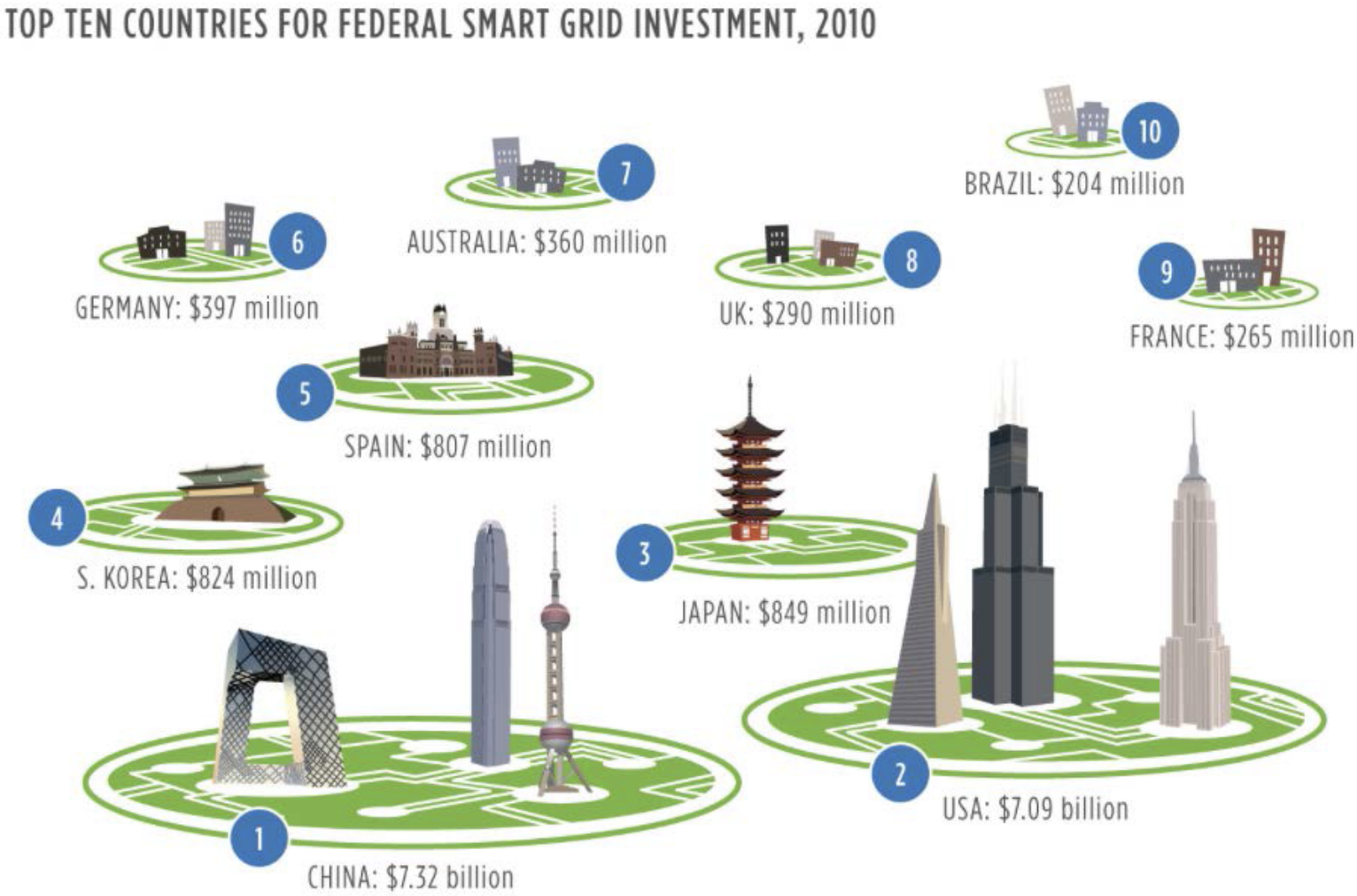
# 1. Smart Grids market in Spain

## Global smart grid market opportunity




**Note:**
The above figures represent planned investment in smart grid infrastructure.

# 1. Smart Grids market in Spain



# 1. Smart Grids market in Spain

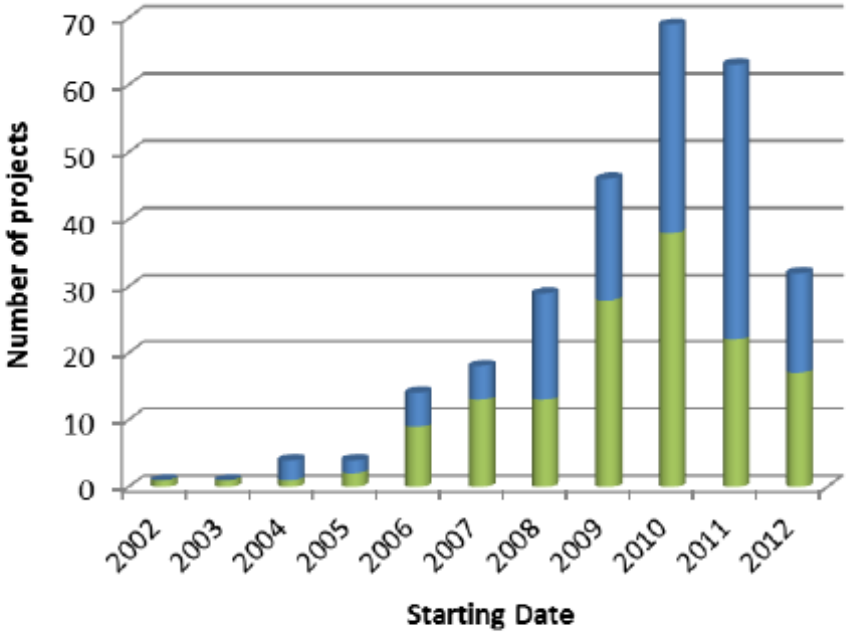



Figure 10 — Number of R&D and demonstration SG projects

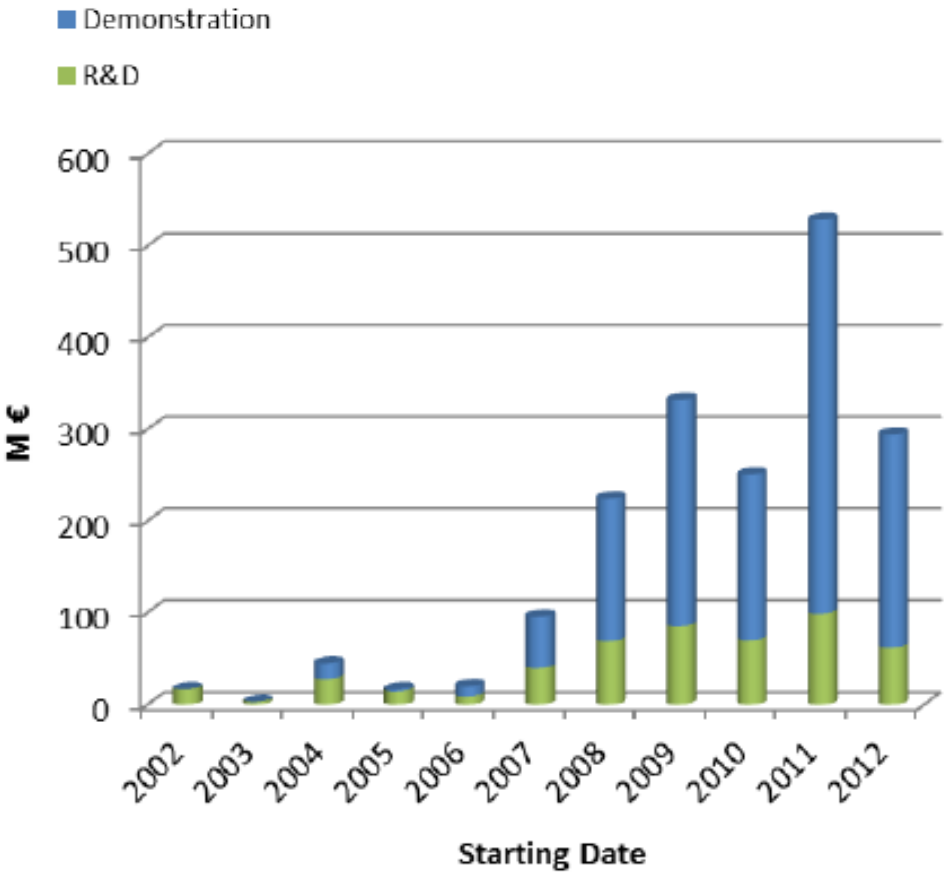
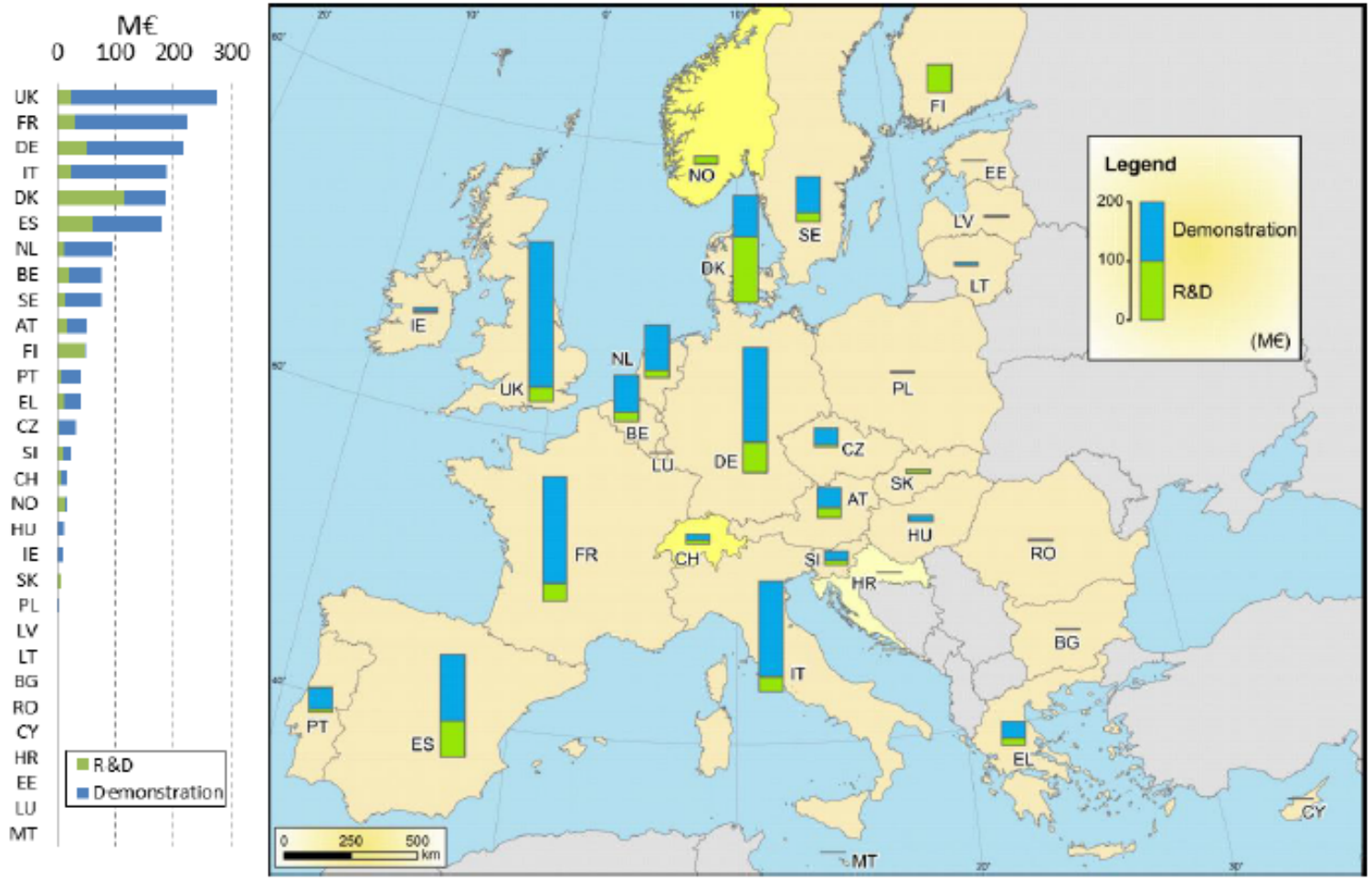



Figure 11 — Budget of R&D and demonstration SG projects start

Source: Joint Research Centre - European Commission

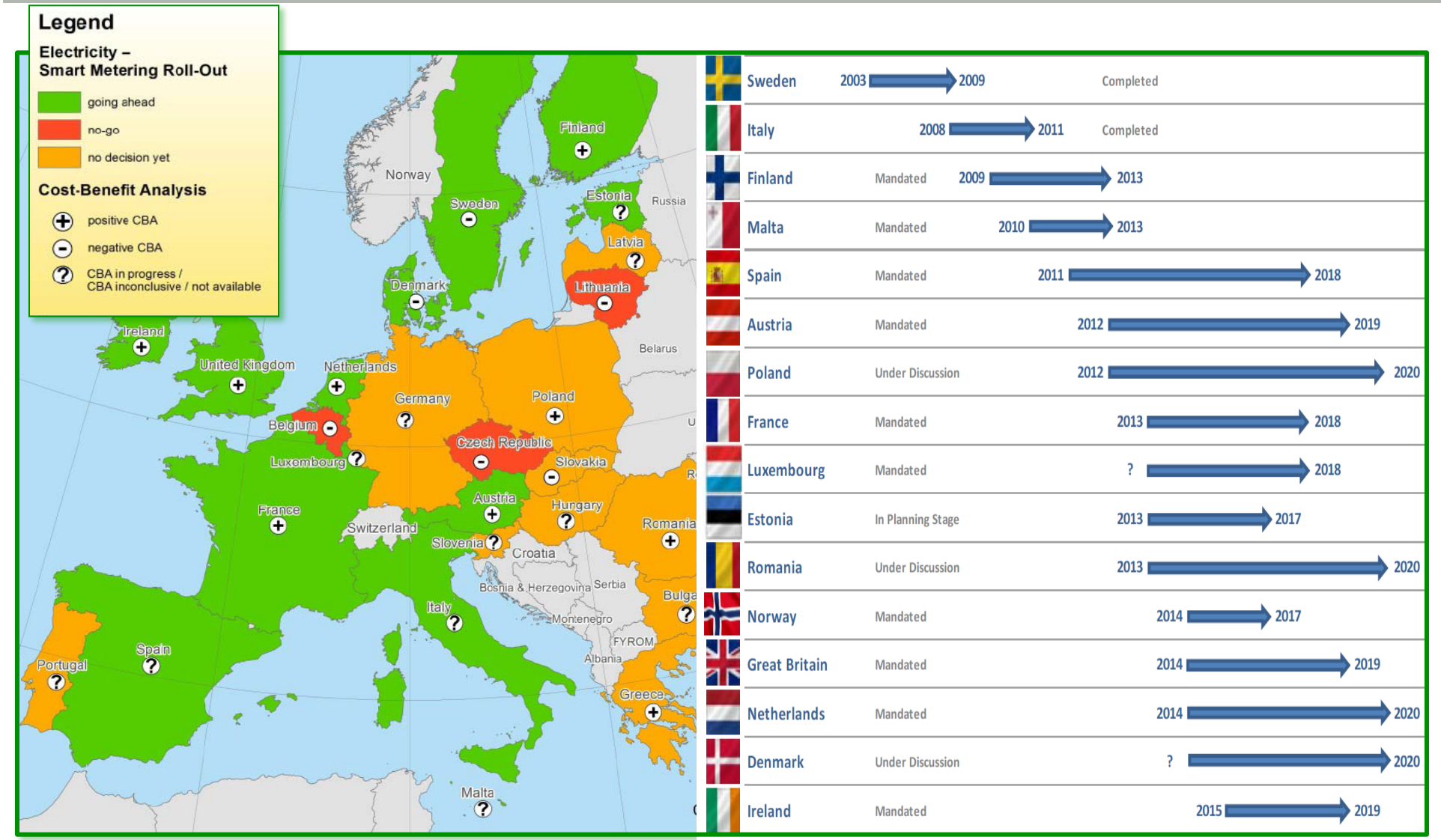
# 1. Smart Grids market in Spain




**Figures 13 – Investments in R&D and demonstration SG projects across Europe**

Source: Joint Research Centre - European Commission

# 1. Smart Grids market in Spain




Electricity, source: European Commission

# 1. Smart Grids market in Spain

## Smart Grids will favor the sustainable growth of the Spanish economy

Increased **productivity and GDP growth**

↑ 0.2%-0.35% (€2,300-3,800M/year)

**Undertaking and leading the process to transform the power system with Smart Grids could improve Spain's Gross Domestic Product +0.2% to +0.35%**

- Development of the Spanish power and technology sectors and creation of jobs
- Adjustment of the trade balance by reducing imports of primary fossil energy
- Increase in country productivity derived from an improvement in supply quality

Job **creation**

↑ 40,000-50,000 jobs

**Developing Smart Grids will generate 20,000 direct jobs in Spain and 20,000 to 30,000 indirect jobs in high added value activities**

- Manufacturing electrical and communications components
- Setting up, installing in situ and maintaining electrical and communications installations
- Developing companies on energy management businesses

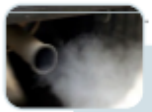
Reduction of **energy dependence**

↓ 5.3 p.p[1] (€4,050M/year)

**Spain's energy dependence could be cut 5.3 percentage points by 2020 (10,800 ktep less primary fossil energy)**

- Increase in the power system's energy efficiency
- Effective integration of renewable energies and e-vehicles[2]

**For the power sector, energy dependence could drop 12.2 p.p. by 2020**



Reduction of **CO2 emissions**

↓ 3.7%[1] (€160M/year)

**Spain's CO2 emissions could drop 3.7% by 2020 (15 million tons less)**

- Less fossil fuels used to generate electricity
- Effective integration of renewable energies and e-vehicles[2]

**For the power sector, CO2 emissions could drop by 15% by 2020**

1. Includes integration of renewable energies, the effect of Smart Grids and the addition of 1 million e-vehicles. 2. One million e-vehicles.

THE BOSTON CONSULTING GROUP

# SG benefits will total between €19 and 36B, generating value of 2 to 3.5 times the investment needed for their development

For each stakeholder, investments and efforts need to be aligned with benefits

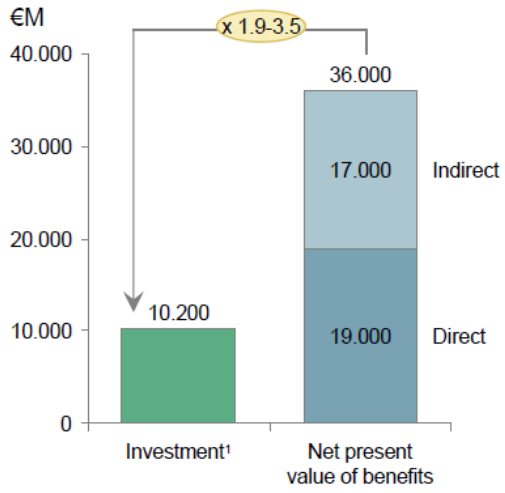
## Investment required

### Grid elements

- **Smart meters**
- Automation of **Medium and High Voltage**, including remote control, **supervision and metering elements**
- Advanced **applications** to **manage grids and operate power system**
- Smart elements in **High Voltage**

### Customer elements

- **Power management systems** that respond to system's price signaling, adapting customers' consumption patterns




For each stakeholder, investments and efforts need to be aligned with benefits
- Regulated businesses: reasonable compensation
- Liberalized businesses: attractive business plans

## Intrinsic benefits

### Direct benefits

- ✓ Reduction of **energy intensity and flattening the demand** curve
- ✓ Increase in system's **energy efficiency** (fewer losses)
- ✓ Increase in systems' **operation and maintenance efficiency**
- ✓ Optimization of **assets utilization and extension** of assets life cycle

### Indirect benefits

- ✓ Increase in the country's productivity from **improvements in power supply quality**

**Additionally, Smart Grids will facilitate distributed energy resources' integration (renewables, distributed generation and e-vehicle, etc.)**

1. Average investment value. Arithmetic mean between minimum and maximum scenarios.
Note: Benefit scenarios calculated as the net present value of the total benefit in 20 years, assuming an 8% discount rate.

# 2. Reference of main SG initiatives

## 2. Reference of main SG initiatives

1. Smart grids →combination of traditional facilities with state-of-the-art ICTs technology
2. Compliance with legislation = opportunity
3. 60 M€ project investment
   - Roll out of (200,000+27,000) smart meters
   - HV/MV/LV: 1,100 secondary substations and 3 rural primary substations
   - Integration of DG and EVs
4. Improved energy and environmental efficiency
5. Driver project for Basque companies
6. Reference project worldwide

## An open public solution: PRIME protocol

Smart meter vendors

PRIME solutions providers

CIRCUTOR

Itron

Landis+Gyr manage energy better

ORBIS energía inteligente

Sagemcom

SOGECAM INDUSTRIAL, S.A.

ZIV

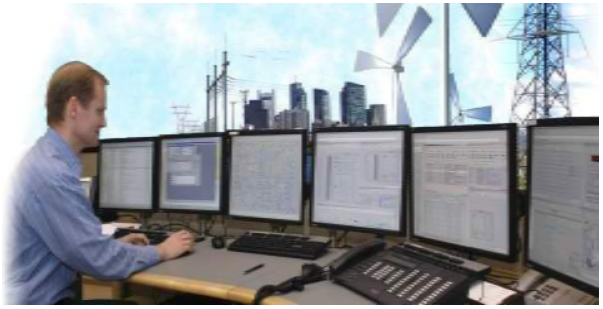
µSysCom

Texas Instruments

ADD semiconductor

IBERDROLA

bidelek sareak



# Smart secondary substations:

1,100 secondary substations will be upgraded to provide the following services:

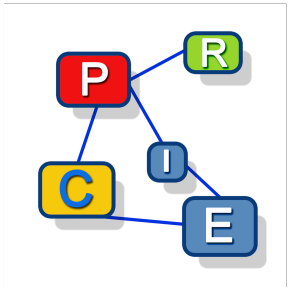
- 235 with remote management (level 1 - basic)
- 700 with remote management and monitoring (level 2 – monitoring)
- 165 with remote management, monitoring and automation (level 3 – automation)

## PRICE: "Smart Grid Project in Henares Region"

PRICE (Proyecto de Redes Inteligentes en el Corredor del Henares) is a joint Demonstration Project led by IBERDROLA and GAS NATURAL FENOSA, consisting in the deployment of a global intelligent electrical network solution for their power distribution systems in a shared geographic area, in order to get the experience and knowledge in deploying and managing intelligent power systems.


Figure 1: PRICE geographic area

PRICE Project



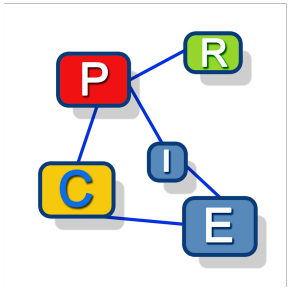
# 2. Reference of main SG initiatives

- ❑ Monitor, automation and remote control the MV/LV power network, improving its observability, operation and maintenance.
- ❑ Improve the integration of already existing distributed generation (73.300 kW).
- ❑ Forecasting and monitoring system for distributed generation based on state estimation.
- ❑ DSVC system for voltage stabilization in MV feeders and LV generators.
- ❑ Specification of the Distributed Generation Control Center
- ❑ Contribution to interoperability and common open standards.

IBERDROLA

gasNatural fenosa

## PRICE Project




| |
|---|
| 500.000 inhabitants involved |
| 200.000 customers |
| > 1.500 MV/LV secondary substations |
| Urban, Semi-urban and Rural network topologies |
| Budget: 34 M€ (excluding smart meters cost) |
| Large collaboration: 21 partners |
| Execution period: 2011-2014 |

# 2. Reference of main SG initiatives

smartcity

www.smartcitymalaga.es

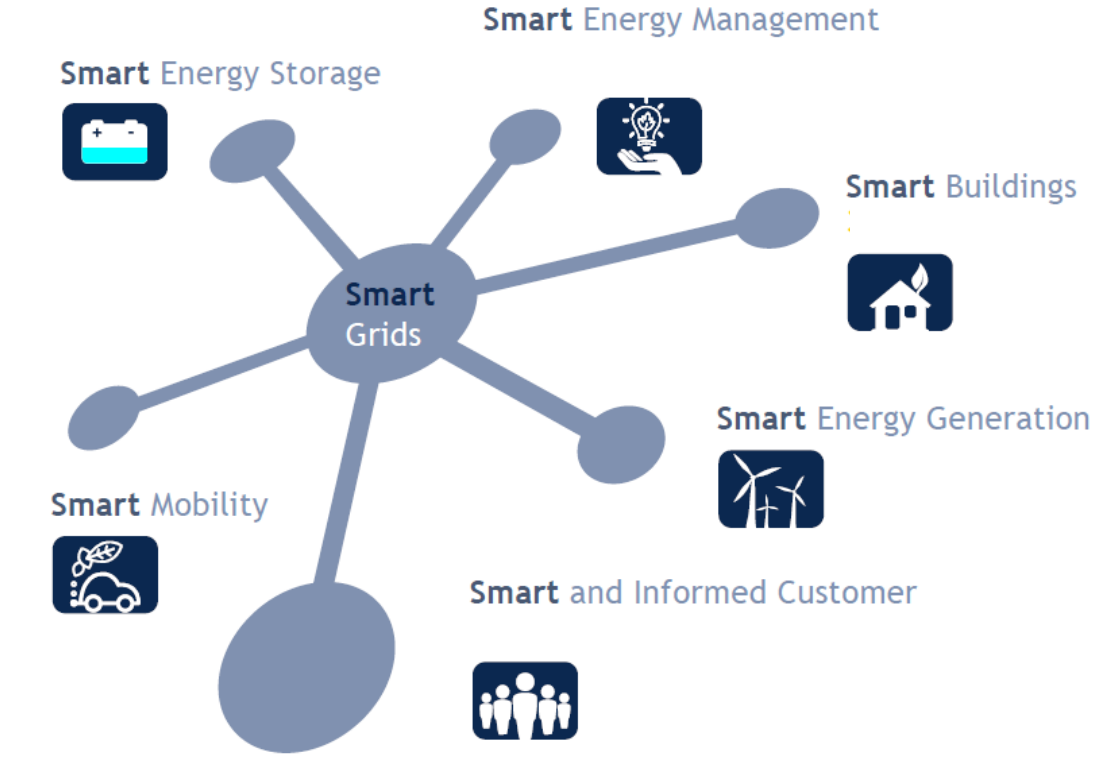
endesa

SmartCity aims to an optimal integration of renewable energy into the grid, bringing the generation to the demand through the establishment of **new management models for the energy micro-generation**, considering energy storage for building HVAC, street lighting and electric transport.

SmartCity will encourage the use of **electric vehicle,** with the installation of charging posts and the introduction of a fleet of EVs.

New **smart meters** for remote management will enable more sustainable electricity consumptions.

**Advanced and remote telecommunications** enable new energy management and enhancing service quality.

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Smart City ihas been funded by FEDER (European Funds for Regional Development)

# 3. Opportunities for microgrids projects

## Plataforma Española de Redes Eléctricas

FutuRed

### Inventario de microgrids existentes en España

# 3. Opportunities for microgrids projects

# TECNALIA's microgrid platform

## Power Sources:

- Diesel Generator (2x55kW)
- µTurbine (50kW)
- Pacific Power Sources - programmable network simulator- (2x62.5kVA/50kW )
- PV single phase (0.6kW and 1.6kW)
- PV (3.6kW three phase)
- Wind Turbine (single phase 6kW)
- Ballard Fuel cell (1 kVA)
- DC power source (125 kW)

## Static Switch:

- Islanded – Grid connected

## Main switching board:

- Three busbars (Three phase)
- Most devices can be connected to any busbar

## Tests switching board:

- Concentrates all load banks at a single connection

## Communication network:

- Ethernet, WiFi, RS 485 & RS 232, TCP/IP, ModBus…

## Storage:

- Flywheel (250kVA)
- Ultracapacitor bank (48V 2.8MJ)
- Battery banks (48V-1925Ah and 24V-1120Ah)

## Controllable load:

- Resistive load bank (150kW & 55kW)
- Reactive load banks (up to 200kVARr reactive or capacitive)

## Other:

- Line simulator (R & X)
- DC Network, Rectifier and PM1000 Inverters (2x100kW)
- Hidrotec
- EV platform
- Kubik

## Conclusions on the inventory

- 19 installations / 5 MW
- Purpose: pilot projects / demo / experimental platform
- Most of them can work connected or isolated
- All of them are private distribution networks connected to the main grid (utility) in a single point
- There is a regulation under discussion (net balance) that can mean a great opportunity for microgrids deployment in Spain
- Several laboratories have developed experimental capacities for technology testing
- Some of them are even working under real conditions

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# Thank you for your attention

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